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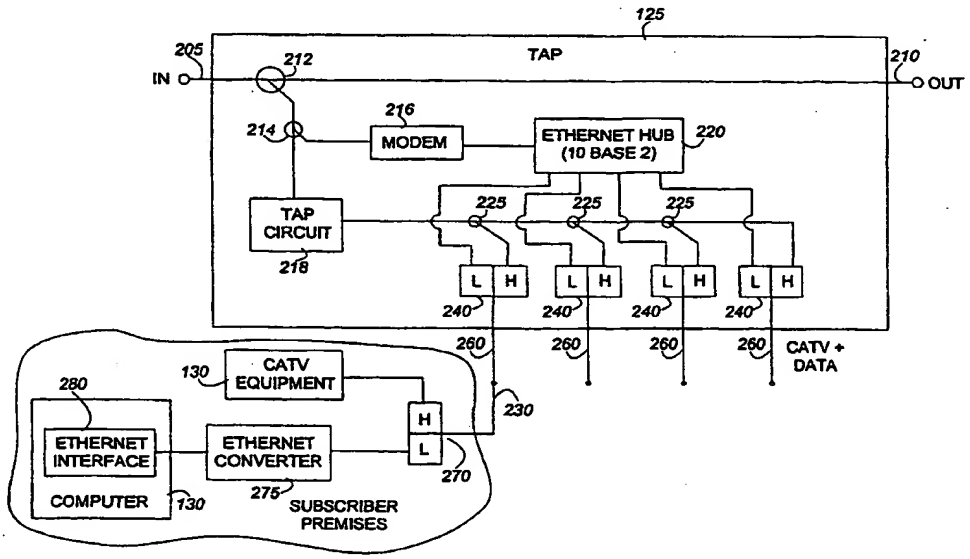

(57) Abstract

A tap (125) for use in a cable television system (100) includes a conventional tap circuit (218) for receiving a downstream electrical signal and splitting the received electrical signal into multiple output signals, including television information, to subscriber drops. The tap (125) also includes a modem (216) for processing the received electrical signal to demodulate it and thereby generate a demodulated signal including data. A packetizer (220), such as an Ethernet hub, is coupled to the modem (216) for receiving the demodulated signal and arranging the data into data packets for transmission from the tap (125) to subscriber drops. The data packets can be transmitted to subscribers using the same drops that are used for transmission of the television information or different drops that are dedicated to providing data packets.

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CABLE TELEVISION TAP INCLUDING MODEM

FIELD OF THE INVENTION

This invention relates generally to cable television systems, and more specifically to the supply of data over a cable television system.

BACKGROUND OF THE INVENTION

Conventional cable television systems include a distribution system for transmitting information to subscribers over optical equipment, electrical equipment, or some combination of the two. In many systems, headend equipment transmits optical information signals over optical fibers to a node, where the optical information signals are converted to electrical signals that are then transmitted over an electrical communication medium, such as coaxial cables. The electrical signals are amplified, as necessary, for further distribution throughout the communication system, and taps situated along the communication medium are used to split off portions of the electrical signals to subscribers of the system. The electrical signals are then processed by subscriber equipment, such as televisions, set top terminals, and computers.

In some more recent cable television systems, modulated data can be also be provided via the cable television distribution system to cable modems that are located in subscriber homes and businesses. A cable modem typically filters the television information from the incoming signal so that the data can be demodulated and then processed by a subscriber's computer.

Although the provision of data over the cable television distribution system occurs at relatively fast speeds as compared to data transmitted over conventional telephone lines, many subscribers are unwilling to purchase and use cable modems. In large part, this is due to the higher cost of cable modems and service over the cable television system. Also, since cable modems are not customarily provided as internal components of personal computer systems, use of a cable modem requires the subscriber to wire an additional stand-alone unit to his or her computer. Given the amount of desk space, wires, and cables that are already required to assemble conventional computers, printers, monitors, scanners, and other data processing equipment, this option is not usually desirable from the subscriber's point of view.

Thus, there exists an opportunity to reduce the costs and inconveniences associated with data distribution over cable television systems.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagram of a cable television system including a tap having a radio frequency (RF) modem according to the present invention.

FIG. 2 is an electrical block diagram of a tap including a modem in accordance with the present invention.

FIG. 3 is an electrical block diagram of an alternative tap including a modem in accordance with the present invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

FIG. 1 is a block diagram of a communication system 100, such as a cable television system, for providing information to subscribers of the system 100. The system 100 includes a transmitter, such as headend equipment 105, for transmitting information signals comprising data, video, and audio. The information may be processed by an optical transmitter 116 so that it is transmitted optically over fiber optic cable 118 to an optical node 120, where the optical signal is converted into an electrical signal. The electrical signal is further transmitted over an electrical communication medium, such as coaxial cable 122, for distribution throughout the communication system 100 in a downstream, or forward, direction.

In accordance with the present invention, electrical signals from a data source 112, such as an information services provider (ISP) 108, can also enter the communication system 100. This can be done, for instance, by employing interface equipment, e.g., a cable modem termination shelf (CMTS) 110, to receive and modulate data provided by an ISP 108. The data enters the system, such as via a directional coupler 114, as a modulated carrier.

Preferably, the modulated data signal is transmitted within a frequency channel that is separate from that of other forward, or downstream signals, which include conventional cable television signals. By way of example, the forward spectrum can be provided in a range of 50 to 750 MHz or higher and can be divided into 6 MHz forward channels. The data channel can include one or more of the 6 MHz channels that are not used for transmission of the cable television channels. Alternatively, the data signal could be provided at frequencies of less than 50 MHz, such as at 10 MHz. In this manner, the

electrical signal that is distributed over the system 100 includes a forward component comprising cable television channels and at least one data channel. The electrical signal may also include a reverse component that is transmitted back to the headend equipment 105 and perhaps to the ISP 108. Portions of the forward electrical signal are then split off by taps 125 to subscriber equipment 130, such as computers, televisions, and set top terminals.

Referring next to FIG. 2, a tap 125 according to the present invention is shown. The tap 125 includes an input port 205 for receiving the forward electrical information signal, some of which is passed through the tap 125 to a main output port 210 that couples the signal back into the cable television distribution system. However, at least a portion of the signal is split off by directional coupler 212, which is coupled to a tap circuit 218 that processes the forward signal in a conventional manner.

The output of directional coupler 214 is, according to the present invention, coupled to a modem 216 that is included within the tap 125. The internal modem 216 demodulates the modulated data in a conventional manner to provide baseband data. More specifically, when the modem 216 is a DOCSIS compliant modem, a tuner or other filtering circuit within the modem 216 provides the modulated data included on the data channel(s) to demodulating circuitry within the modem 216. A packetizer 220 coupled to an output of the modem 216 then arranges the data into data packets that are transmitted at a lower frequency, such as approximately 10 MHz. The packetizer 220 may be, for example, an Ethernet hub for arranging data into packets according to an Ethernet protocol, and it will be appreciated that the modem 216 itself may provide Ethernet data.

The output of the tap circuit 218 is coupled, such as by directional couplers 225, to highpass filter portions of diplex filters 240, and the outputs of the packetizer 220 are coupled into lowpass filter portions of the diplex filters 240. Each diplex filter 240 combines a low frequency data packet signal, provided by the packetizer 220, with a higher frequency cable television signal, provided by the tap circuit 218, to generate a combined signal that is provided to a subscriber output port 260, or "drop."

Although only four subscriber drops 260 are shown in FIG. 2, it will be appreciated that this number was chosen only for purposes of illustration, and that the tap 125 could include different numbers of subscriber output ports. Since the data packets and the cable television information are, according to this embodiment of the present invention, transmitted into the subscriber premises on a single communication medium, such as a

coaxial cable 230, it will be further appreciated that, when the packetizer 220 comprises an Ethernet hub, the hub is preferably a 10Base2 hub.

The forward electrical signal, which comprises data packets and cable television information, is then provided to another diplex filter 270 that is preferably located within or near the subscriber premises. The highpass filter portion of the diplex filter 270 provides the higher frequency cable television signal to conventional cable television equipment 130, and the lowpass filter portion of the diplex filter 270 provides the lower frequency data signal to a host device 130 that can process the data. The host device 130 can, for instance, include a computer 130 having an Ethernet interface 280 for receiving and processing the data. Since computers often include a conventional 10BaseT Ethernet interface 280, an Ethernet converter 275 may be employed to convert the 10Base2 Ethernet signal to a 10BaseT Ethernet signal, if necessary.

The subscriber equipment 130 may also generate data for transmission back through the system 100 (FIG. 1) in an upstream, or reverse, direction. In this case, data from the subscriber equipment 130 is preferably transmitted at less than 50 MHz. More specifically, the data generated by the cable television equipment 130 may be transmitted in the frequency range of 20-50 MHz, and the data generated by the computer 130 may be transmitted at frequencies below 20 MHz. It will be appreciated that, if the computer and cable television equipment transmit at these respective frequency ranges, the highpass filter portions of the diplex filters 270, 240 should pass signals at approximately 20 MHz and greater, and the lowpass filter portions of the diplex filters 270, 240 should pass signals at less than approximately 20 MHz. It should be understood that the frequencies that are passed by lowpass and highpass filters of the diplexers 270, 240 may be different than those described herein, but should correspond to the different frequency spectrums that are provided in the system 100.

In the reverse path, data generated by the cable television equipment 130 is combined, via the diplex filter 270, with lower frequency data generated by the computer 130. The reverse signal is provided back to the tap 125, where the higher frequency data, which originates at the cable television equipment 130, is filtered by the diplex filter 240 and provided to the tap circuit 218 for processing in a conventional manner. The lower frequency data from the computer is filtered by the diplex filter 240 and provided to the Ethernet hub 220 then modulated by the modem 216. The outputs of the tap circuit 218 and the modem 216 are, in the reverse direction, combined by directional couplers 214, 212 and transmitted upstream from port 205 of the tap.

Referring next to FIG. 3, a tap 300 manufactured in accordance with an alternative embodiment of the present invention is depicted. The tap 300, like tap 125, operates to provide the downstream signal to both the modem 216 and the tap circuit 218. The tap circuit 218 provides a forward signal that is provided to subscriber cable television ports 260 via directional couplers 305. The modem 216 provides demodulated data to a packetizer 310 that arranges the data into data packets according to a known signal protocol. The packetizer 310 can be, for instance, an Ethernet hub that provides outputs to a separate set of subscriber data ports 315.

When a tap 300 is used to provide physically and electrically separate drops for cable television signals and for data signals, the Ethernet hub 310 can be a 10BaseT hub so that data can be provided to the Ethernet interface 280 of a computer over standard twisted pair wires 330. The cable television signals can be provided to cable television equipment 130 via a standard coaxial cable 230. Since it may be undesirable to expose the cable television equipment 130 to the higher level data signals, a highpass filter 340 can be employed to filter the data signals and pass the cable television signals. The highpass filter 340 can, as shown, be included within the subscriber premises or could alternatively be included within the tap 300.

According to this alternative embodiment, reverse data signals from the computer 130 travel directly to the Ethernet hub 310, and reverse data signals from the cable television equipment 130 travel through the highpass filter 340, if present, and through any directional couplers 305 to the tap circuit 218. The return signals are then combined into the reverse signal that is transmitted upstream through the system 100.

Although use of the tap 300, which provides separate cable television drops and data drops, may require less complex circuitry within the tap 300, transmitting data packets to the subscriber premises on the same cable that is used for transmission of the cable television signals, as is the case with the tap 200, is preferred since this arrangement involves less labor and fewer cables from the tap 200 to the subscriber home or business. As a result, use of the tap 200 may result in less maintenance and, ultimately, less expense.

According to the present invention, a modem 216 and related circuitry for processing data signals sent over a cable television distribution system have been included in a cable television tap 125, 300, rather than in the subscriber home or business. This modem 216 processes data signals for multiple subscribers so that the cost of the modem 216 is conveniently shared by a number of subscribers, resulting in less expensive cable modem services for consumers. Additionally, a subscriber who wishes to use the modem 216

located in the tap 125, 300 need not purchase a separate stand-alone unit that has to be wired into his or her computer. Instead, the modem 216 and most of the related circuitry is physically located at the tap 125, 300 outside the subscriber's premises so that no additional space within the premises is required. Preferably, the only equipment that is located in the subscriber's work area is the conventional Ethernet interface 280, which can be incorporated within the computer 130.

A primary advantage of the present invention is that the modem 216 is shared by a number of users. It should therefore be understood that the modem 216 does not necessarily have to be included within the tap 125, 300 itself, but could instead be provided as a separate modem module (not shown) external to the tap to process the downstream signals. The data packets from such a modem module could then be coupled back into the cable distribution system on the subscriber side of the tap. This might be desirable, for example, in existing cable television systems in which replacement of each and every tap is not cost effective.

What is claimed is:

CLAIMS

1. A tap for use in a cable television system, comprising:

a tap circuit for receiving an input signal and splitting the input signal into output signals;

a modem for receiving the input signal and demodulating the input signal to generate a demodulated signal including data; and

a packetizer coupled to the modem for receiving the demodulated signal and arranging the data into data packets for transmission from the tap.

2. The tap of claim 1, further comprising:

an input port coupled to the tap circuit and the modem for providing the input signal thereto; and

a plurality of subscriber ports coupled to the tap circuit and the modem for transmitting the output signals and the data packets from the tap.

3. The tap of claim 1, wherein the output signals include cable television information transmitted at greater than 50 MHz.

4. The tap of claim 3, wherein the data included in the data packets is transmitted at less than 50 MHz.

5. The tap of claim 4, further comprising:

a diplex filter coupled to an output of the tap circuit and to an output of the modem for combining the data with the cable television information to generate a forward signal for provision to subscriber equipment.

6. The tap of claim 1, wherein the packetizer comprises an Ethernet hub.

7. The tap of claim 1, wherein the output signals provided by the tap circuit are transmitted to subscribers over coaxial cables.

8. The tap of claim 1, wherein the data packets provided by the packetizer are transmitted over telephone cables.

9. A tap for use in a cable television system, comprising:

an input port for receiving an input signal;

a tap circuit for receiving the input signal and splitting the input signal into cable television signals;

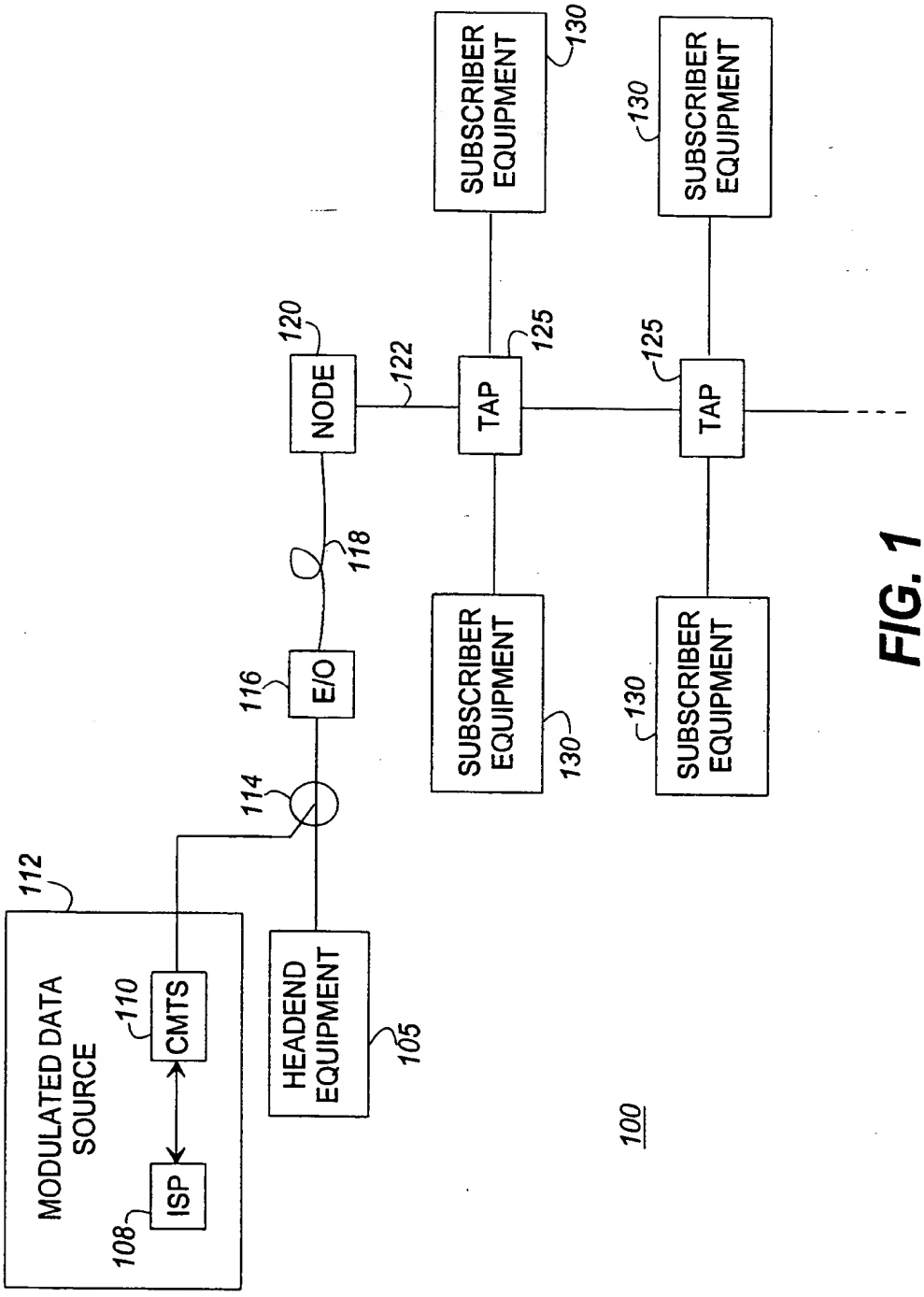
a modem for receiving the input signal and demodulating the input signal to generate a demodulated signal including data;

a packetizer coupled to the modem for receiving the demodulated signal and arranging the data into data packets for transmission from the tap;

diplex filters for combining the data packets with the cable television signals to generate output signals; and

subscriber ports coupled to the diplex filters for transmitting the output signals from the tap.

10. The tap of claim 9, wherein the packetizer comprises an Ethernet hub.


MODULATED DATA SOURCE
112
ISP
108
CMTS
110
HEADEND EQUIPMENT
105
114
E/O
116
118
NODE
120
122
TAP
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TAP
125
SUBSCRIBER EQUIPMENT
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SUBSCRIBER EQUIPMENT
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130
100

FIG. 1

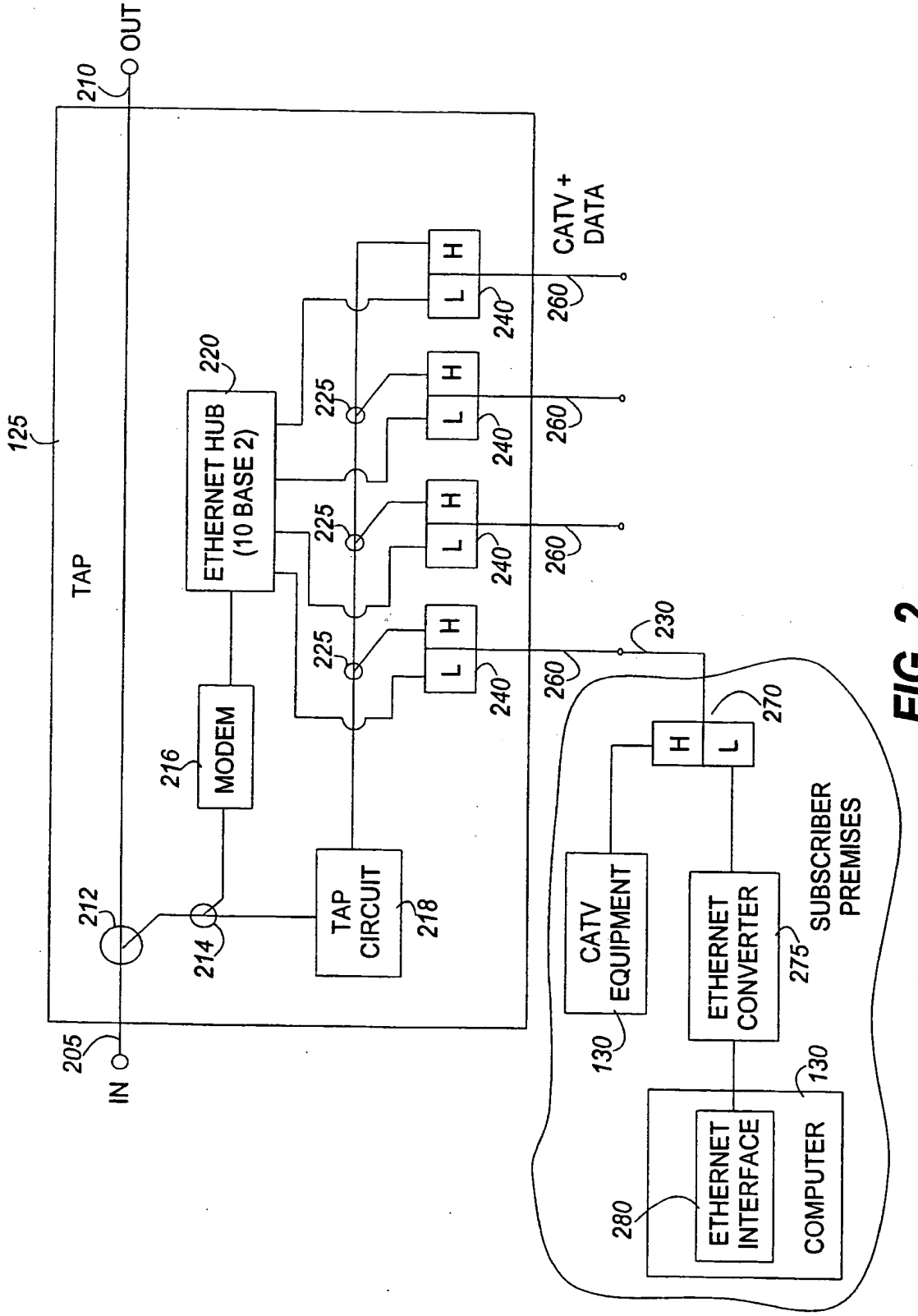

FIG. 2

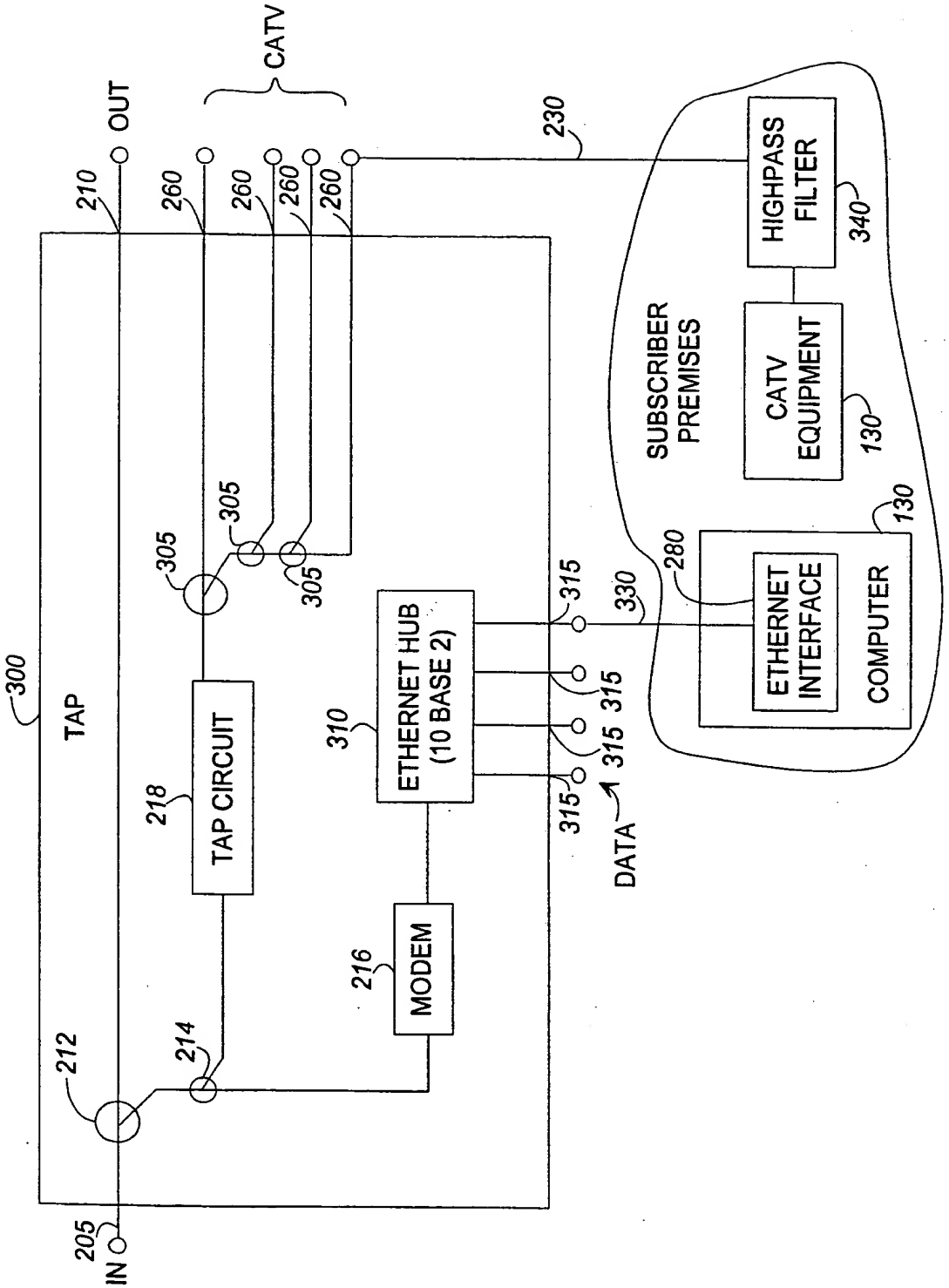

FIG. 3

INTERNATIONAL SEARCH REPORT

Inte ional Application No
PCT/US 99/22944

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N7/10 H04N7/173 H04H1/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04N H04H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 98 05138 A (SCIENTIFIC ATLANTA) 5 February 1998 (1998-02-05) page 20, line 31 -page 22, line 19; figure 6	1,3,4, 6-8
A	page 24, line 27 -page 28, line 9; figure 8	2,5,9,10
A	US 5 793 506 A (SCHMID WOLFGANG) 11 August 1998 (1998-08-11) column 3, line 45 -column 5, line 41; figure 1	1,9
A	WO 96 35283 A (PHILIPS ELECTRONICS NV ;PHILIPS NORDEN AB (SE)) 7 November 1996 (1996-11-07) figures 2,3	1,9

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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